

## Swift Observation of short GRB 080123

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### 1 Introduction

BAT triggered on GRB 080123 at 04:21:57 UT (Trigger 301578) (Ukwatta, *et al.*, *GCN Circ.* 7203). This was a 0.064 sec rate-trigger on a short burst (plus extended emission) with  $T_{90} = 115 \pm 30$  sec. Swift slewed to this burst immediately and XRT began follow-up observations at  $T + 108$  sec, and UVOT at  $T + 111$  sec. Our best position is the XRT location  $RA(J2000) = 338.94226$  deg ( $22h35m46.1s$ ),  $Dec(J2000) = -64.90090$  deg ( $-64d54'03.24''$ ) with an error of 2.1 arcsec (90% confidence, including boresight uncertainties).

### 2 BAT Observation and Analysis

Using the data set from  $T - 240$  to  $T + 962$  sec, further analysis of BAT GRB 080123 has been performed by Swift team (Tueller, *et al.*, *GCN Circ.* 7205). The BAT ground-calculated position is  $RA(J2000) = 338.974$  deg ( $22h35m53.8s$ ),  $Dec(J2000) = -64.930$  deg ( $-64d55'48''$ )  $\pm 4.1$  arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 20% (the bore sight angle was 50.1 deg).

The mask-weighted light curve (Fig. 1) shows two well-separated peaks. The first starts at  $\sim T + 0.3$  sec and is no wider than 64 msec. The second peak starts at  $\sim T + 0.6$  sec with a FRED-like shape and a duration of  $\sim 256$  msec. There is soft extended emission lasting 120 sec.  $T_{90}$  (15 – 350 keV) is  $115 \pm 30$  sec (estimated error including systematics).

The time-averaged spectrum from  $T + 0.3$  to  $T + 122.2$  sec (SHB plus extended emission) is best fitted by a simple power-law model. The power law index of the time-averaged spectrum is  $2.15 \pm 0.54$  ( $\chi^2 = 63.01$  for 57 d.o.f.). The fluence in the 15 – 150 keV band is  $5.7 \pm 1.7 \times 10^{-7}$  erg cm $^{-2}$ . The 1-sec peak photon flux measured from  $T - 0.05$  sec in the 15 – 150 keV band is  $1.8 \pm 0.4$  ph/cm $^2$ /sec. All the quoted errors are at the 90% confidence level.

### 3 XRT Observations and Analysis

XRT team have analyzed data collected during the first three orbits of observation of GRB 080123. Observed data includes 124 s of exposure in WT mode (from  $T + 108$  to  $T + 224$  s) and 7.1 ks in PC mode.

The initial XRT on-board position was centered on a cosmic ray hit. This position was retracted. The XRT position reported in GCN Circ. 7203 was obtained from the first downlinked data, but the error circle given in this circular erroneously ignored the systematic component and was therefore much too small. The new, refined position of the XRT afterglow is

$RA(J2000) = 22h 35m 46.6s$   
 $Dec(J2000) = -64d 54' 03.8''$

with error circle of radius 3.9 arcsec (90%, confidence). As reported by Osborne *et al.* (GCN Circ. 7204), the UVOT-enhanced astrometric position is  $RA, Dec = 338.94226, -64.90090$  which is equivalent to:

RA(J2000) = 22h 35m 46.1s

Dec(J2000) = -64d 54' 03.24"

with error circle of radius 2.1 arcsec (90%, confidence).

The X-ray light curve (Fig. 2) of the source shows a doubly broken power law behavior, with an initial decay with slope  $-1.7 \pm 0.2$ , a first break at  $T + 202 \pm 7$  sec, a second decay phase with slope  $-6.9 \pm 0.5$ , a second break at  $T + 470 \pm 250$  sec and a third decay phase with slope  $-0.7 \pm 0.2$ .

The WT spectrum (Fig. 3) is well fitted by an absorbed power law with photon index  $1.64 \pm 0.09$ , while the PC spectrum can be fitted by a power law with photon index of  $2.1 \pm 0.2$ . Both spectra are consistent with an absorption column of  $NH = (8.1 \pm 2.4)10^{20} \text{cm}^{-2}$ , in excess with respect to the Galactic absorption along the line of sight ( $2.0 \times 10^{20} \text{cm}^{-2}$ , Kalberla et al. 2005). The observed (unabsorbed) flux in the 0.3–10 keV band is  $7.0 \times 10^{-10} (7.9 \times 10^{-10}) \text{erg cm}^{-2} \text{s}^{-1}$  for the WT spectrum and  $1.1 \times 10^{-12} (1.4 \times 10^{-12}) \text{erg cm}^{-2} \text{s}^{-1}$  for the PC spectrum.

## 4 UVOT Observation and Analysis

The Swift/UVOT observed the field of GRB 080123 starting 111 seconds after the BAT trigger. No afterglow candidate has been found in any of the UVOT single or coadded observations inside the XRT enhanced error circle (Osborne *et al.*, *GCN Circ.* 7204). The XRT position is not covered by the U, B and V images.

| Filter | Tstart (s) | Tstop (s) | Exposure (s) | 3-Sigma UL |
|--------|------------|-----------|--------------|------------|
| white  | 112        | 211       | 100          | > 20.5     |
| uvw1   | 651        | 8022      | 577          | > 20.9     |
| uvm2   | 626        | 7817      | 578          | > 20.7     |
| uvw2   | 731        | 14026     | 1188         | > 21.6     |

Table 1: Magnitude limits from UVOT observations

The values quoted above are not corrected for the expected Galactic extinction corresponding to a reddening of  $E(B-V) = 0.03$  mag in the direction of the GRB (Schlegel *et al.*, 1998).

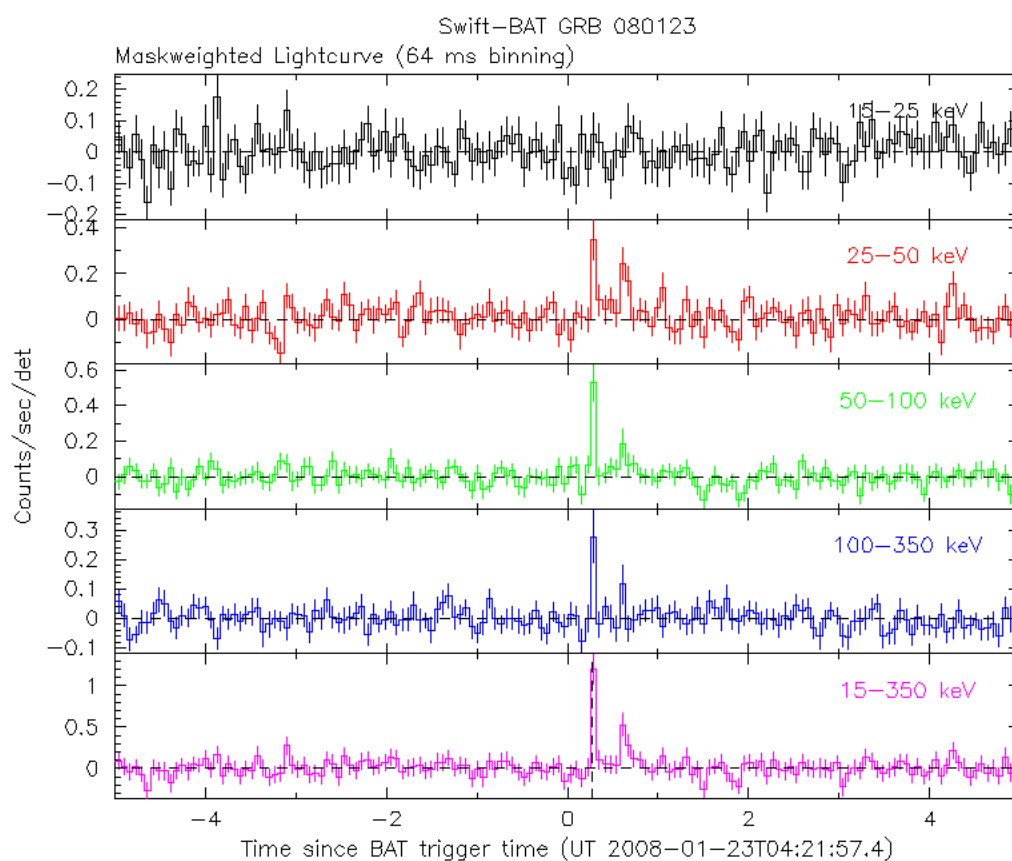


Figure 1: The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and  $T_0$  is 04:21:57 UT.

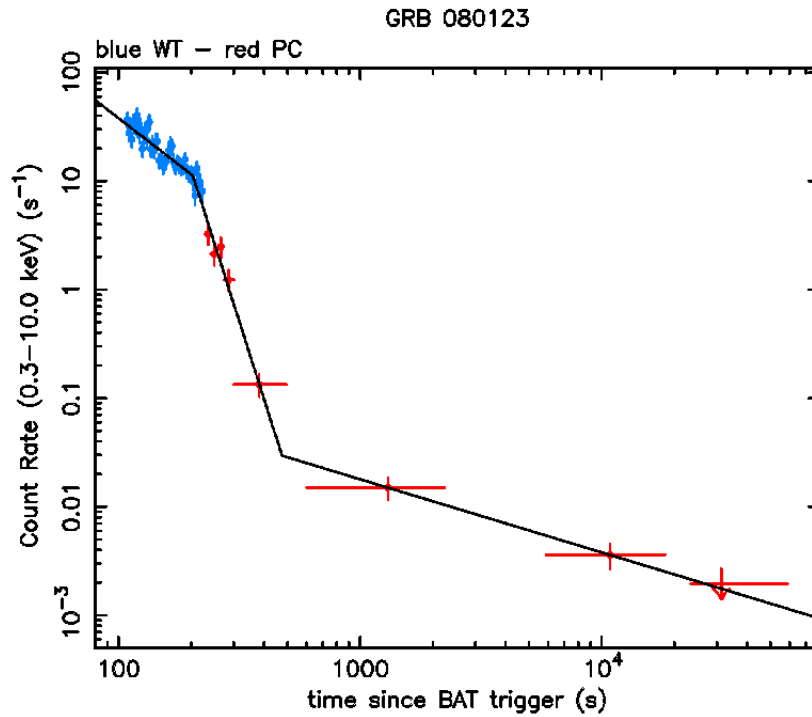


Figure 2: XRT Lightcurve. Counts/sec in the 0.3–10 keV band: Window Timing mode (blue), Photon Counting mode (red). The approximate conversion is 1 count/sec =  $\sim 4.7 \times 10^{-11}$  ergs/cm<sup>2</sup>/sec.

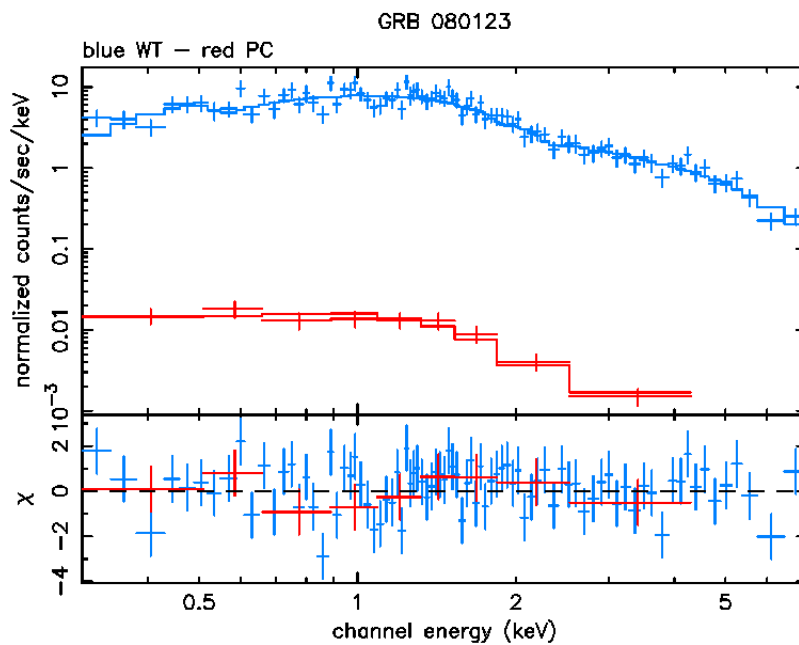


Figure 3: XRT Spectrum. Counts/sec in the 0.3–10 keV band: Window Timing mode (blue), Photon Counting mode (red).